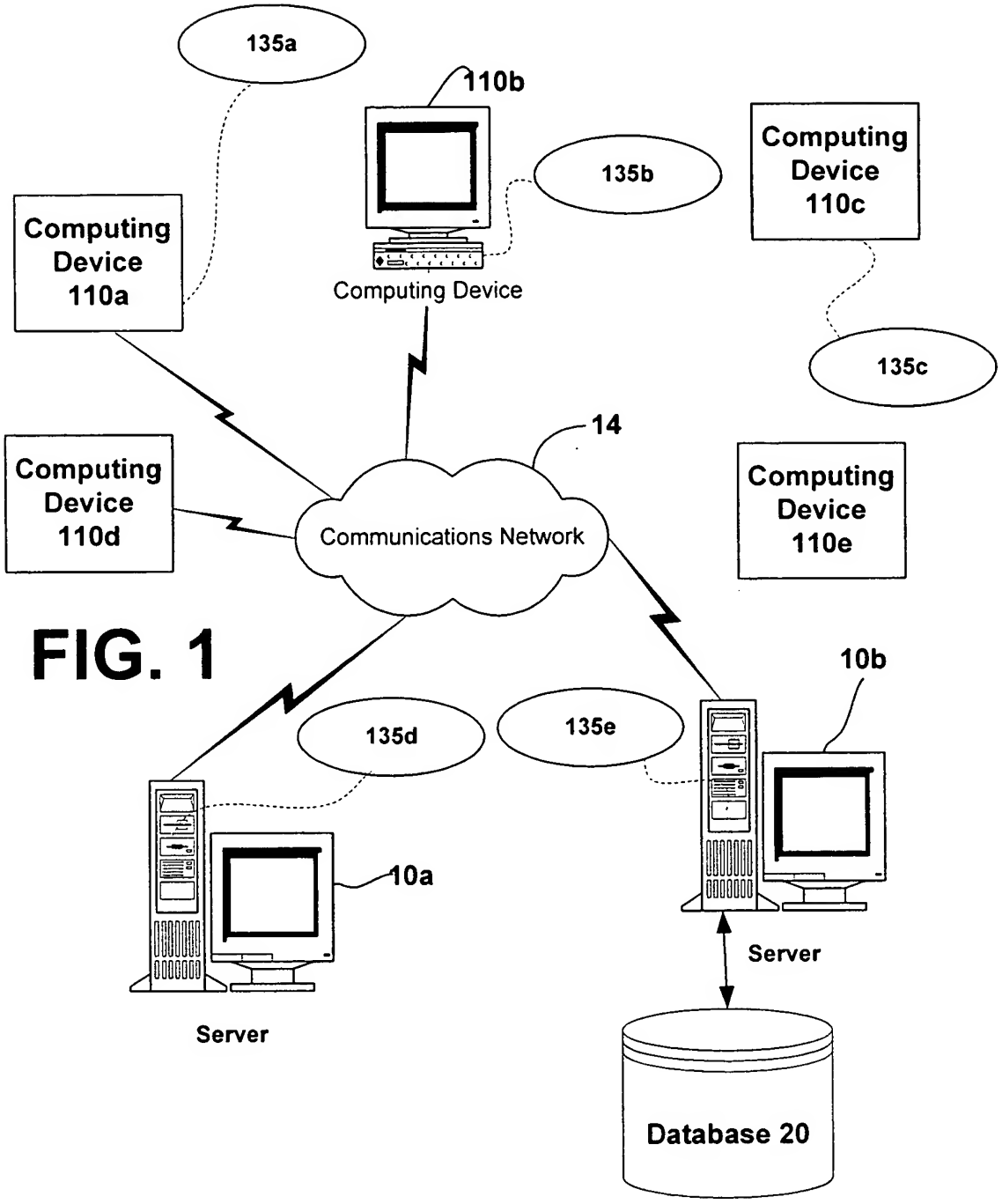

135a
110b
Computing Device 110c
135b
Computing Device 110a
Computing Device
135c
14
Computing Device 110d
Communications Network
Computing Device 110e
10b
135d
135e
10a
Server
Server
Database 20

FIG. 1

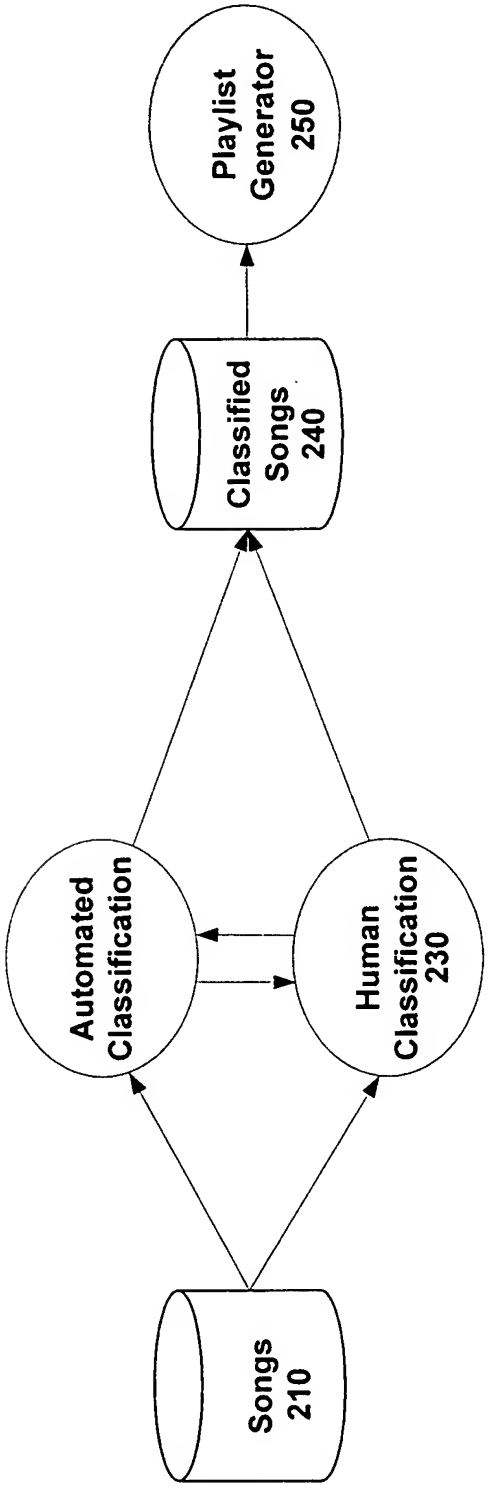

Playlist Generator 250
Classified Songs 240
Automated Classification
Human Classification 230
Songs 210

Fig. 2

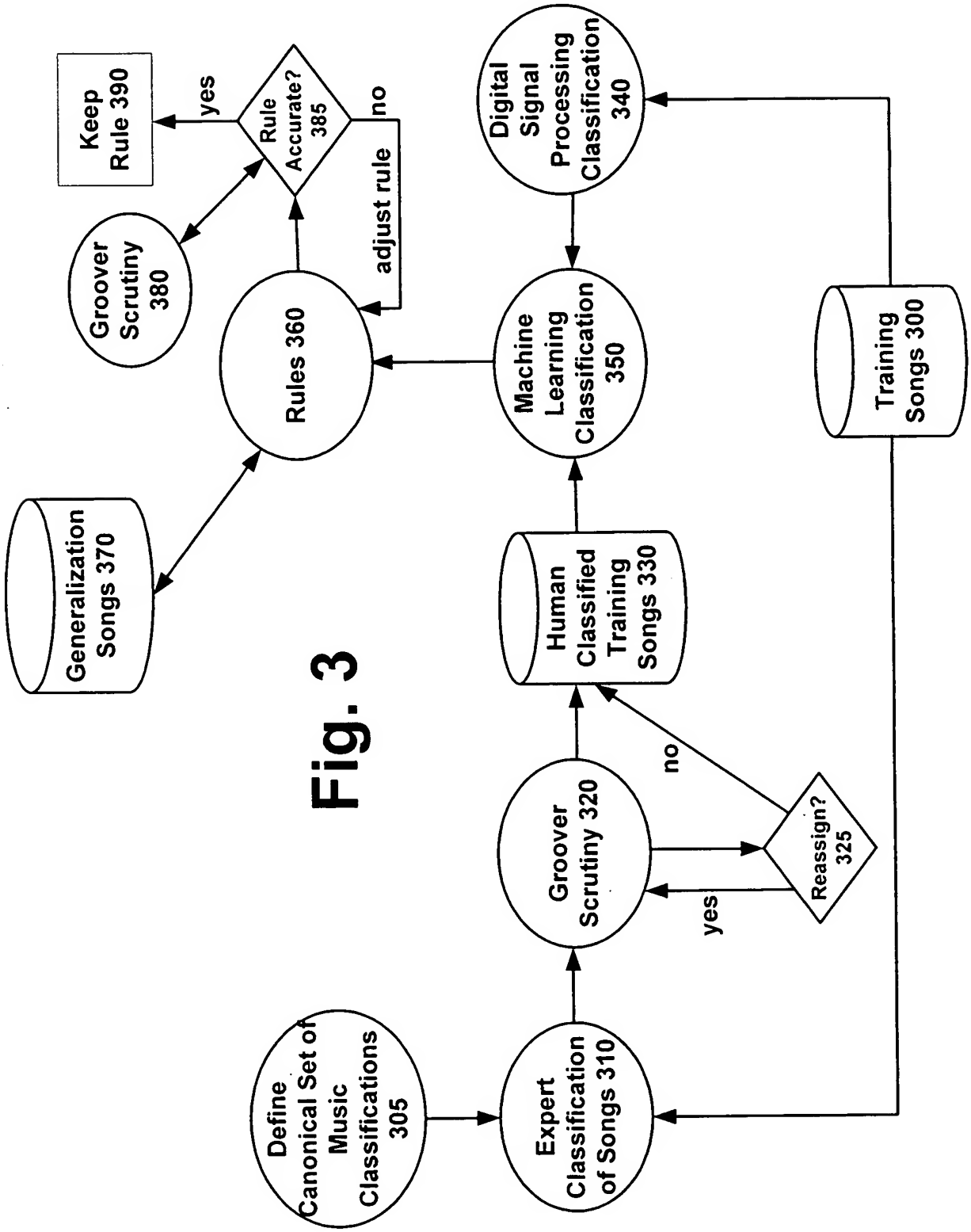
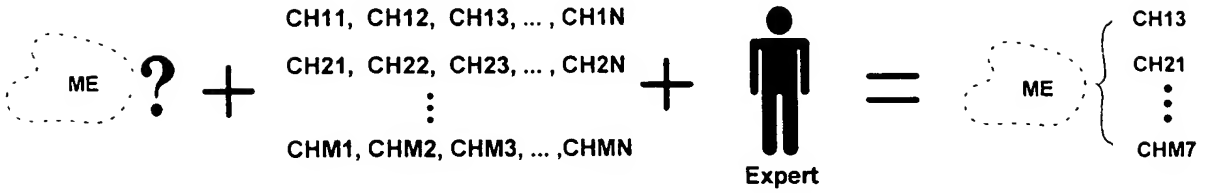
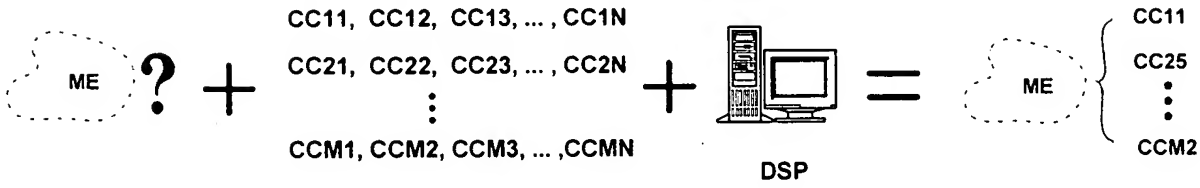

Define Canonical Set of Music Classifications 305
Expert Classification of Songs 310
Groover Scrutiny 320
Reassign? 325
no
yes
Human Classified Training Songs 330
Machine Learning Classification 350
Digital Signal Processing Classification 340
Training Songs 300
Rules 360
Rule Accurate? 385
yes
no
adjust rule
Keep Rule 390
Groover Scrutiny 380
Generalization Songs 370

Fig. 3

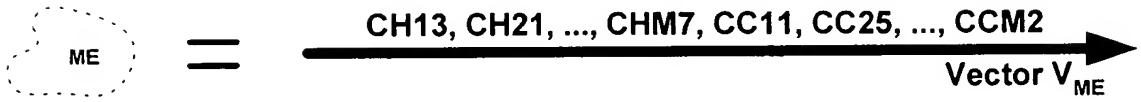
# Fig. 4A



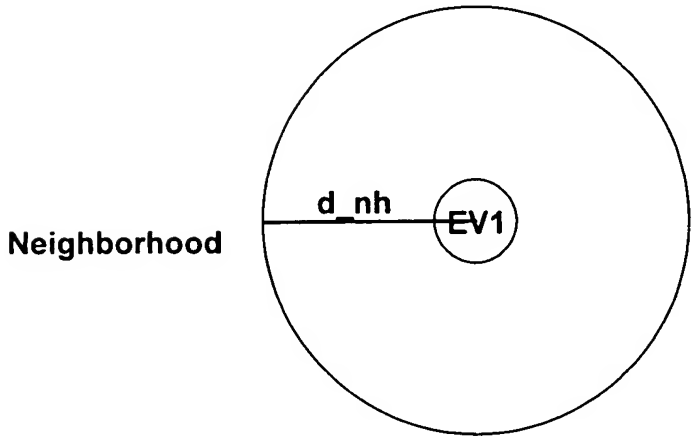

# Fig. 4B



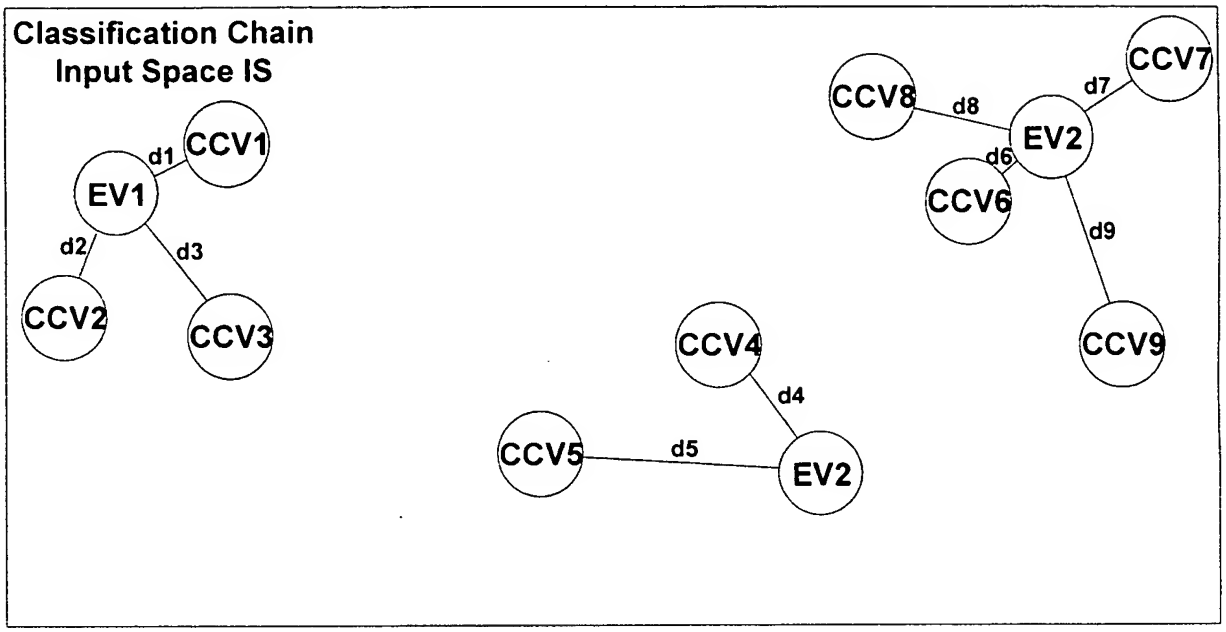

# Fig. 4C



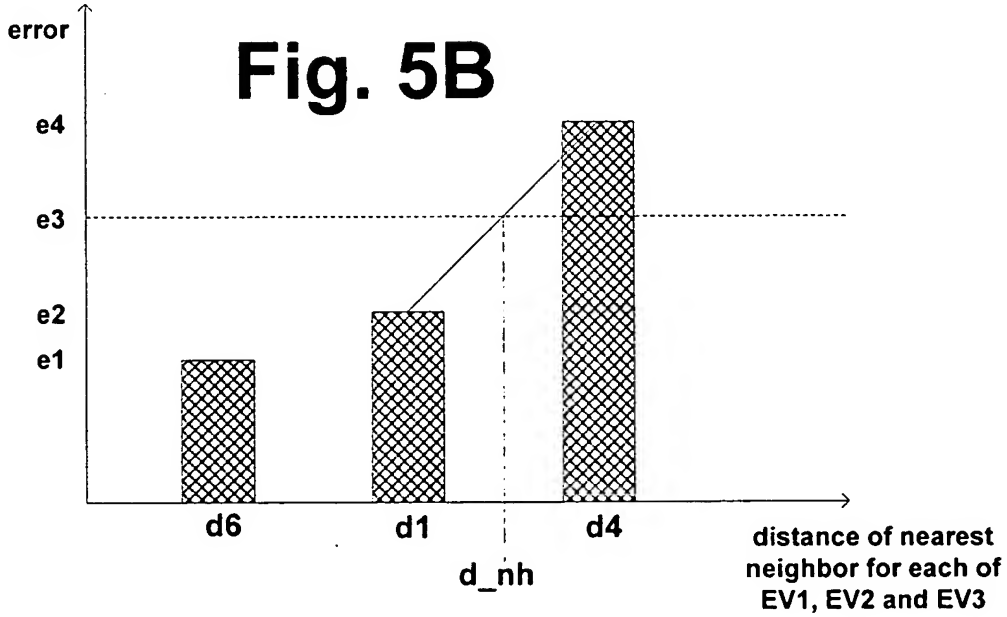

# Fig. 4D



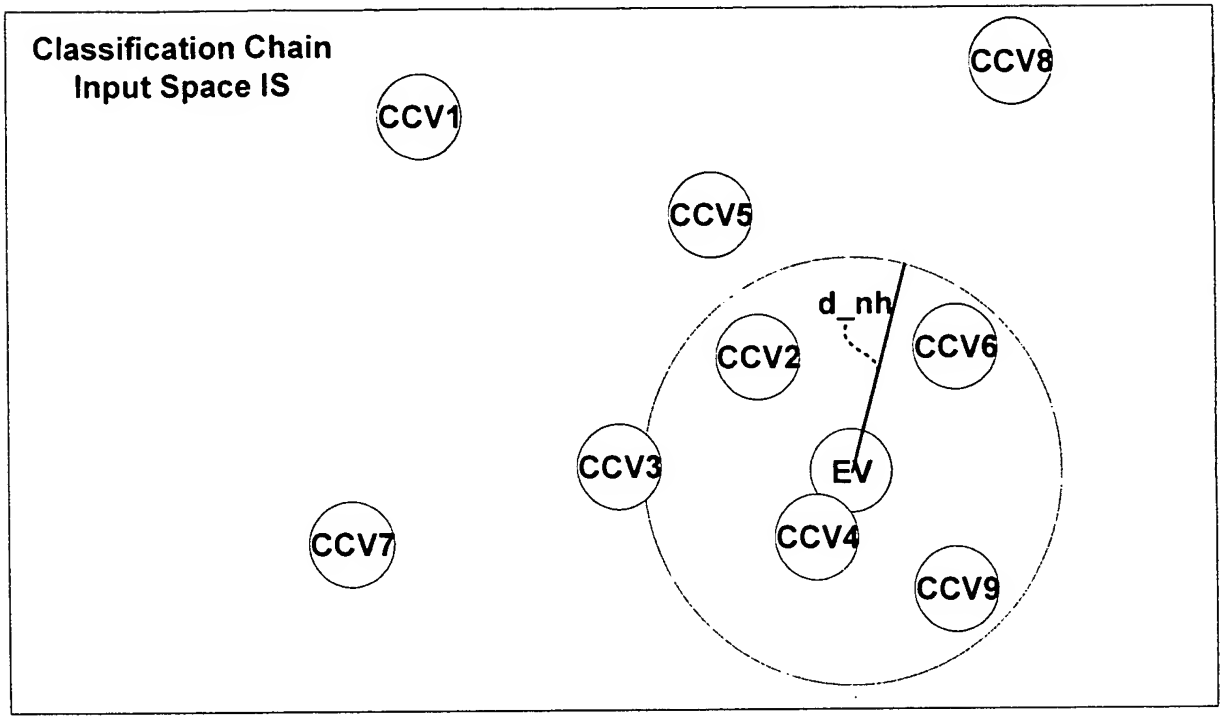
# Fig. 5A


Classification Chain
Input Space IS
CCV1
d1
EV1
d2
d3
CCV2
CCV3
CCV8
d8
EV2
d7
CCV7
d6
CCV6
d9
CCV9
CCV4
d4
CCV5
d5
EV2

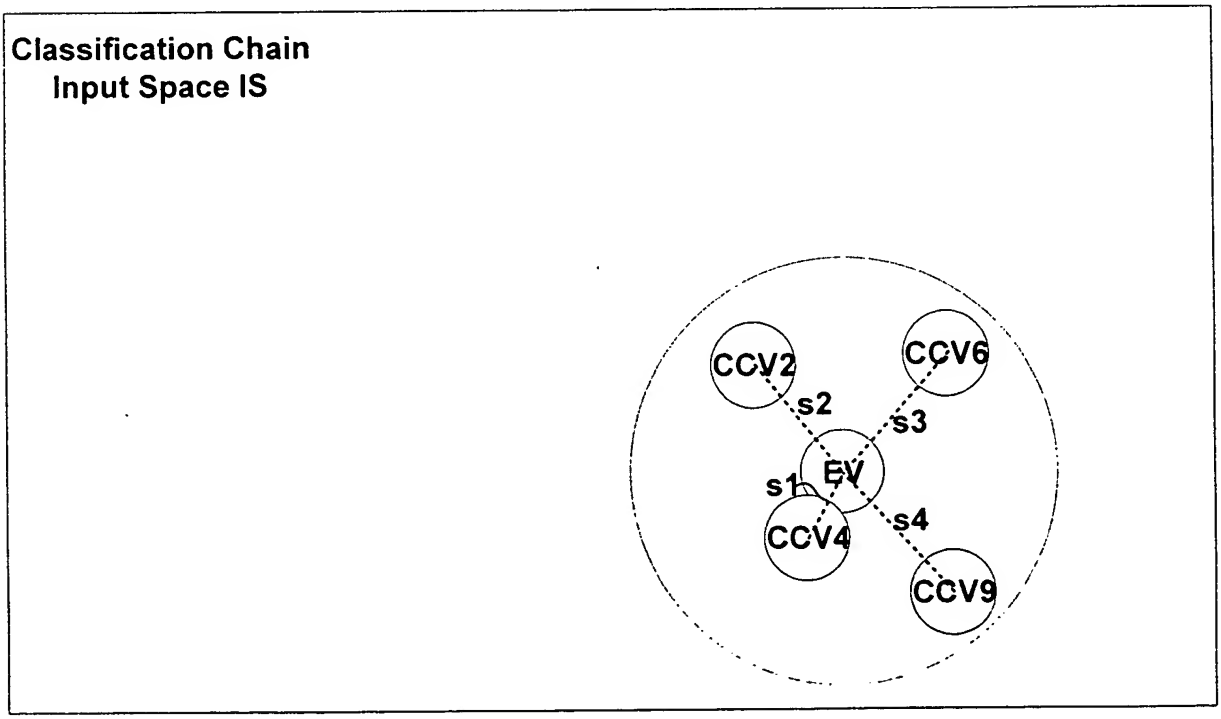
# Fig. 5B


error
e4
e3
e2
e1
d6
d1
d4
d_nh
distance of nearest neighbor for each of EV1, EV2 and EV3

# Fig. 6A


Classification Chain
Input Space IS
CCV1
CCV8
CCV5
d_nh
CCV2
CCV6
CCV3
EV
CCV4
CCV7
CCV9

# Fig. 6B


Classification Chain
Input Space IS
CCV2
CCV6
s2
s3
EV
s1
CCV4
s4
CCV9

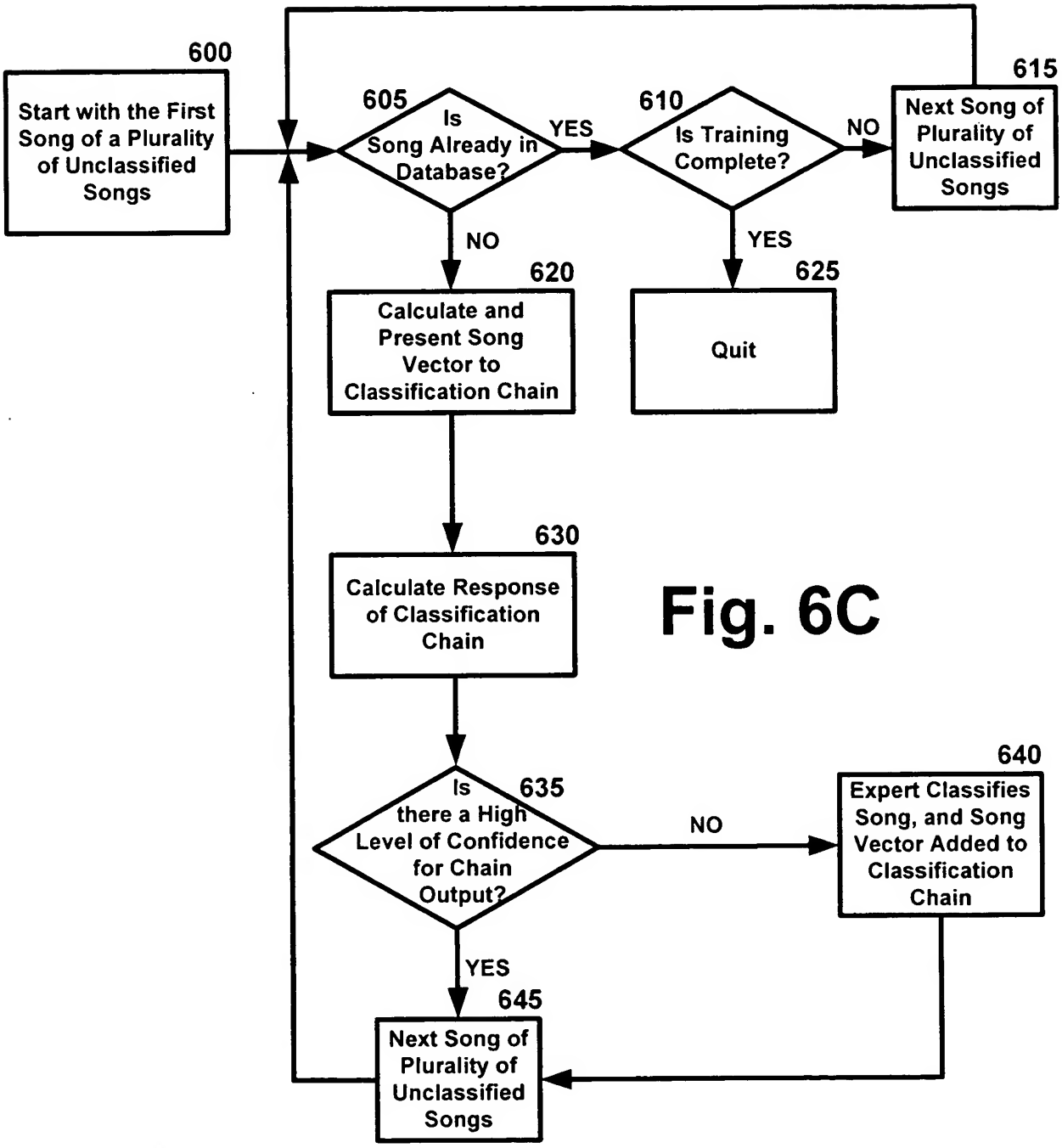

600
Start with the First Song of a Plurality of Unclassified Songs
605
Is Song Already in Database?
YES
NO
610
Is Training Complete?
NO
YES
615
Next Song of Plurality of Unclassified Songs
620
Calculate and Present Song Vector to Classification Chain
625
Quit
630
Calculate Response of Classification Chain
635
Is there a High Level of Confidence for Chain Output?
NO
YES
640
Expert Classifies Song, and Song Vector Added to Classification Chain
645
Next Song of Plurality of Unclassified Songs

Fig. 6C

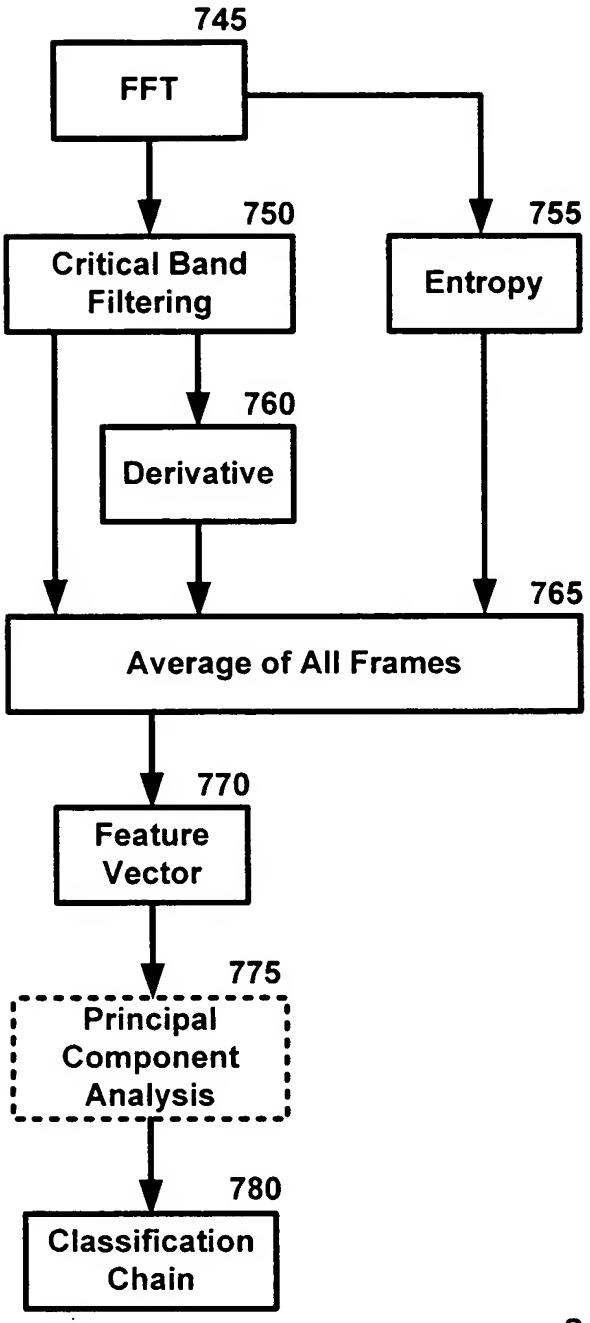

745
FFT
750
Critical Band Filtering
755
Entropy
760
Derivative
765
Average of All Frames
770
Feature Vector
775
Principal Component Analysis
780
Classification Chain

Fig. 7A

Fig. 7B

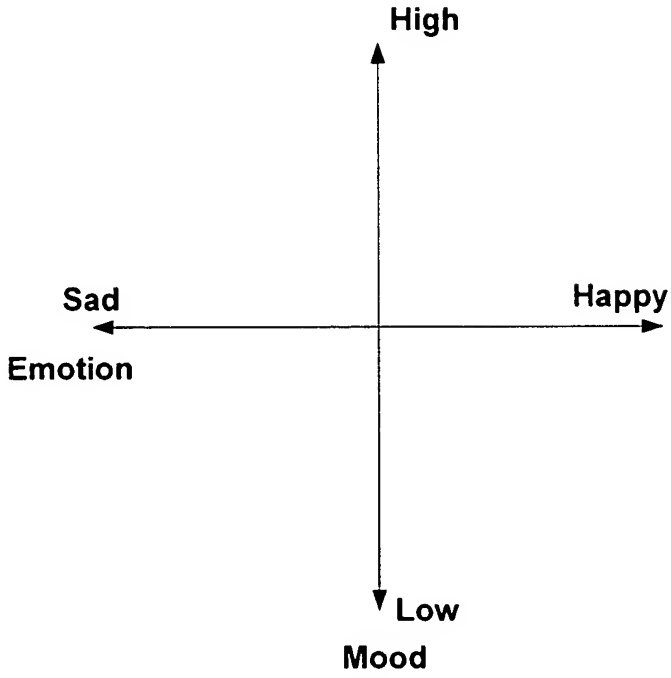
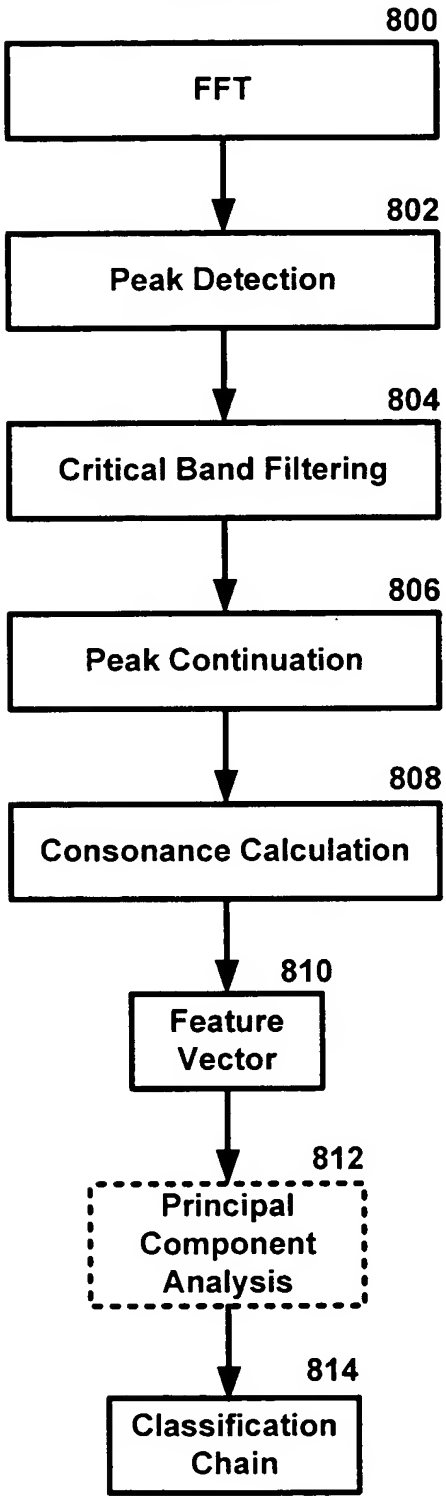
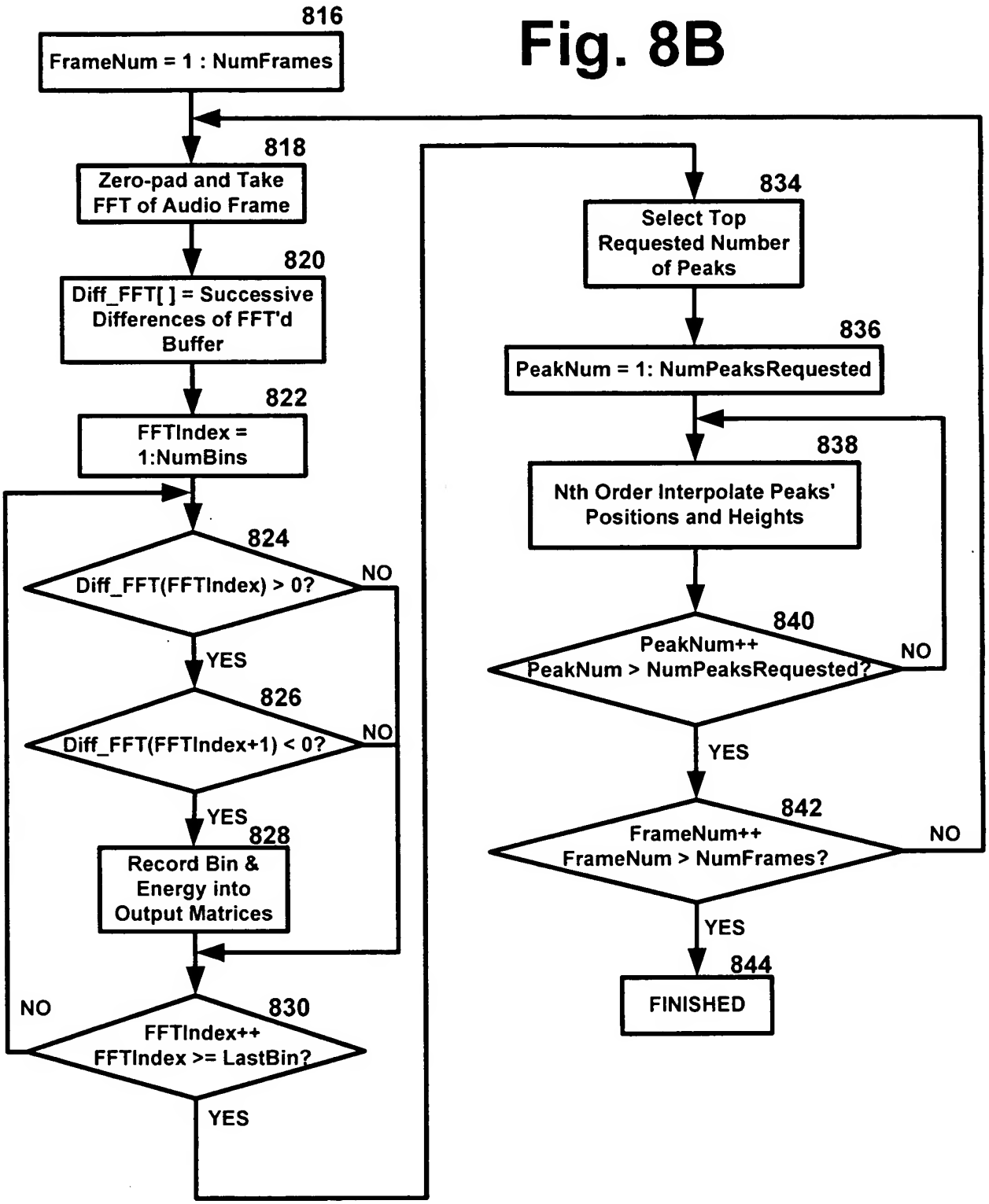

High
Sad
Happy
Emotion
Low
Mood

Fig. 8A


800
FFT
802
Peak Detection
804
Critical Band Filtering
806
Peak Continuation
808
Consonance Calculation
810
Feature Vector
812
Principal Component Analysis
814
Classification Chain

# Fig. 8B


816
FrameNum = 1 : NumFrames
818
Zero-pad and Take FFT of Audio Frame
820
Diff_FFT[ ] = Successive Differences of FFT'd Buffer
822
FFTIndex = 1:NumBins
824
Diff_FFT(FFTIndex) > 0?
NO
YES
826
Diff_FFT(FFTIndex+1) < 0?
NO
YES
828
Record Bin & Energy into Output Matrices
NO
830
FFTIndex++
FFTIndex >= LastBin?
YES
834
Select Top Requested Number of Peaks
836
PeakNum = 1: NumPeaksRequested
838
Nth Order Interpolate Peaks' Positions and Heights
840
PeakNum++
PeakNum > NumPeaksRequested?
NO
YES
842
FrameNum++
FrameNum > NumFrames?
NO
YES
844
FINISHED

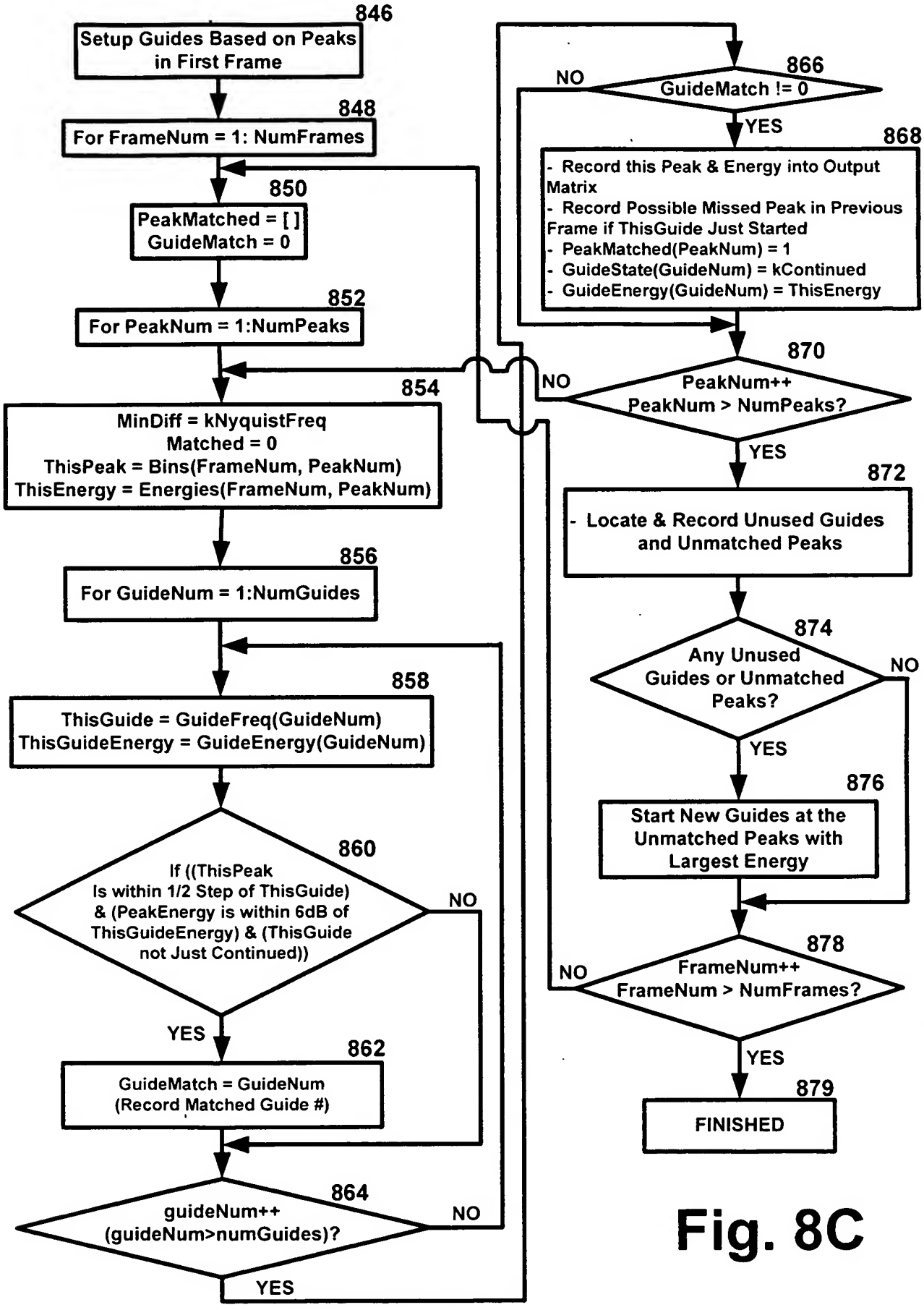
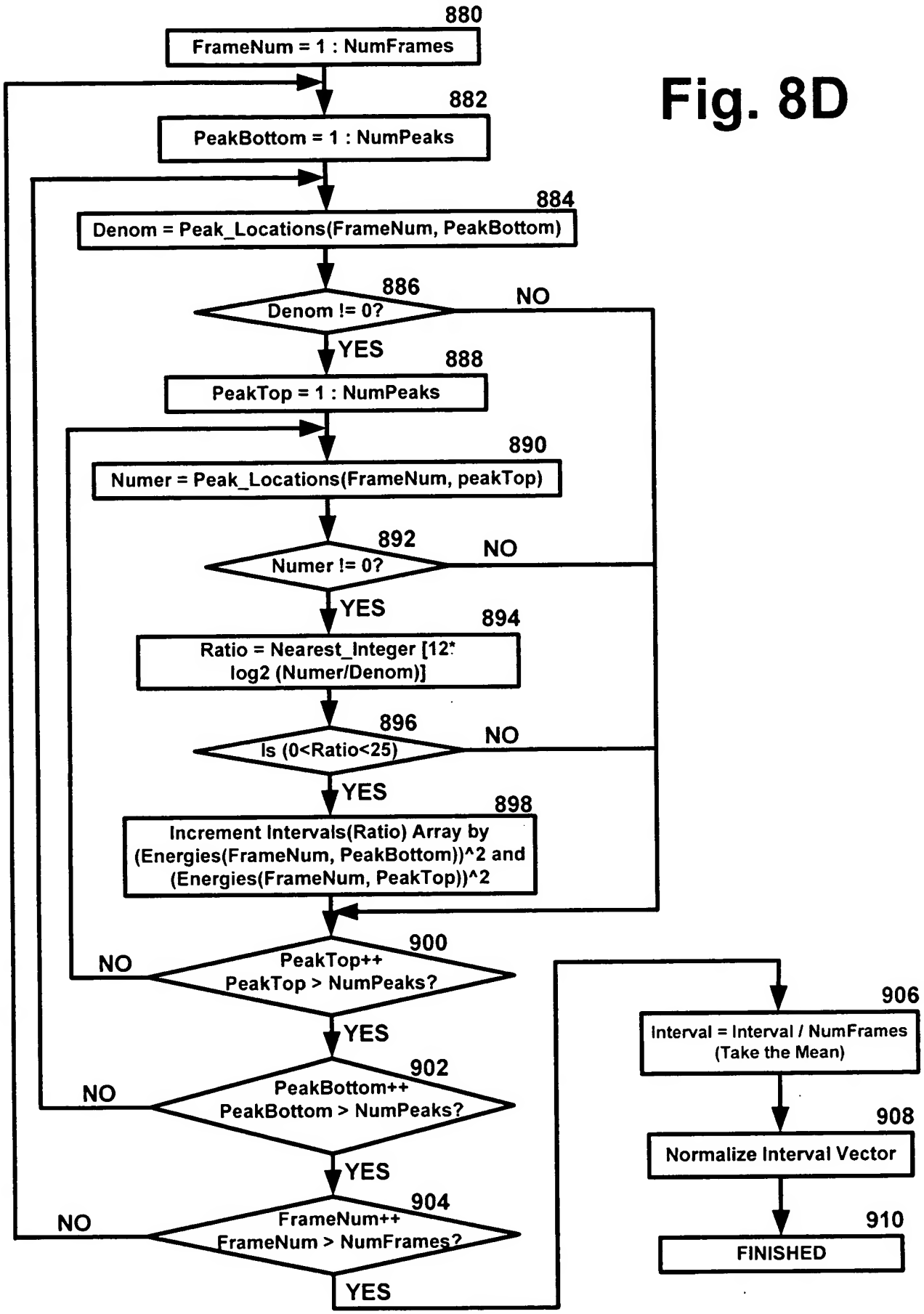
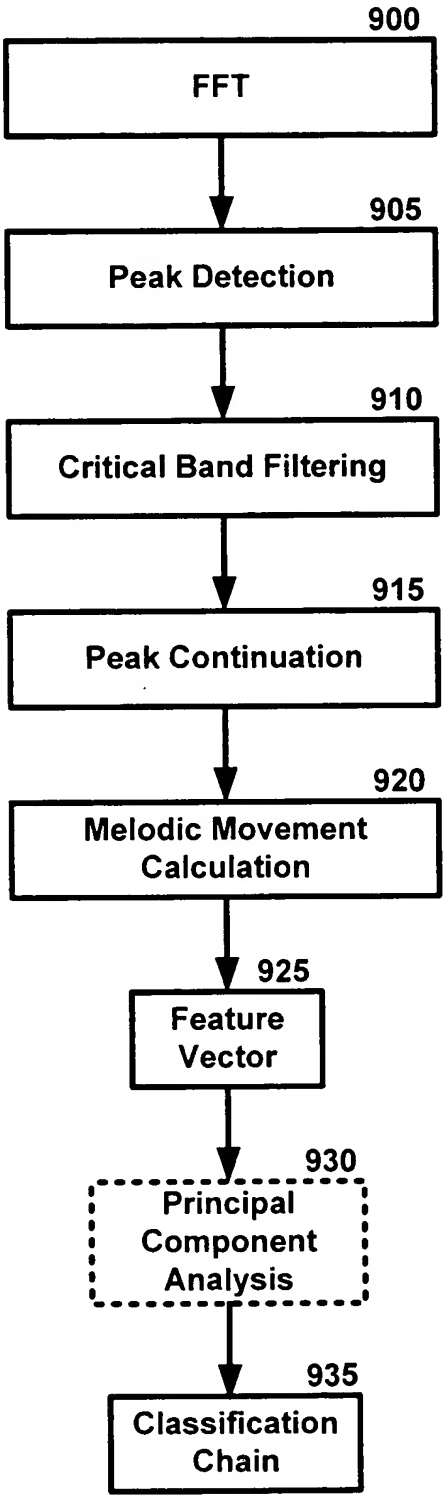

846
Setup Guides Based on Peaks in First Frame
848
For FrameNum = 1: NumFrames
850
PeakMatched = [ ]
GuideMatch = 0
852
For PeakNum = 1:NumPeaks
854
MinDiff = kNyquistFreq
Matched = 0
ThisPeak = Bins(FrameNum, PeakNum)
ThisEnergy = Energies(FrameNum, PeakNum)
856
For GuideNum = 1:NumGuides
858
ThisGuide = GuideFreq(GuideNum)
ThisGuideEnergy = GuideEnergy(GuideNum)
860
If ((ThisPeak Is within 1/2 Step of ThisGuide) & (PeakEnergy is within 6dB of ThisGuideEnergy) & (ThisGuide not Just Continued))
NO
YES
862
GuideMatch = GuideNum
(Record Matched Guide #)
864
guideNum++
(guideNum>numGuides)?
NO
YES
866
GuideMatch != 0
NO
YES
868
- Record this Peak & Energy into Output Matrix
- Record Possible Missed Peak in Previous Frame if ThisGuide Just Started
- PeakMatched(PeakNum) = 1
- GuideState(GuideNum) = kContinued
- GuideEnergy(GuideNum) = ThisEnergy
870
PeakNum++
PeakNum > NumPeaks?
NO
YES
872
- Locate & Record Unused Guides and Unmatched Peaks
874
Any Unused Guides or Unmatched Peaks?
NO
YES
876
Start New Guides at the Unmatched Peaks with Largest Energy
878
FrameNum++
FrameNum > NumFrames?
NO
YES
879
FINISHED

Fig. 8C

Fig. 8D


880
FrameNum = 1 : NumFrames
882
PeakBottom = 1 : NumPeaks
884
Denom = Peak_Locations(FrameNum, PeakBottom)
886
Denom != 0?
NO
YES
888
PeakTop = 1 : NumPeaks
890
Numer = Peak_Locations(FrameNum, peakTop)
892
Numer != 0?
NO
YES
894
Ratio = Nearest_Integer [12* log2 (Numer/Denom)]
896
Is (0<Ratio<25)
NO
YES
898
Increment Intervals(Ratio) Array by (Energies(FrameNum, PeakBottom))^2 and (Energies(FrameNum, PeakTop))^2
900
PeakTop++
PeakTop > NumPeaks?
NO
YES
902
PeakBottom++
PeakBottom > NumPeaks?
NO
YES
904
FrameNum++
FrameNum > NumFrames?
NO
YES
906
Interval = Interval / NumFrames (Take the Mean)
908
Normalize Interval Vector
910
FINISHED

# Fig. 9A


900
FFT
905
Peak Detection
910
Critical Band Filtering
915
Peak Continuation
920
Melodic Movement Calculation
925
Feature Vector
930
Principal Component Analysis
935
Classification Chain

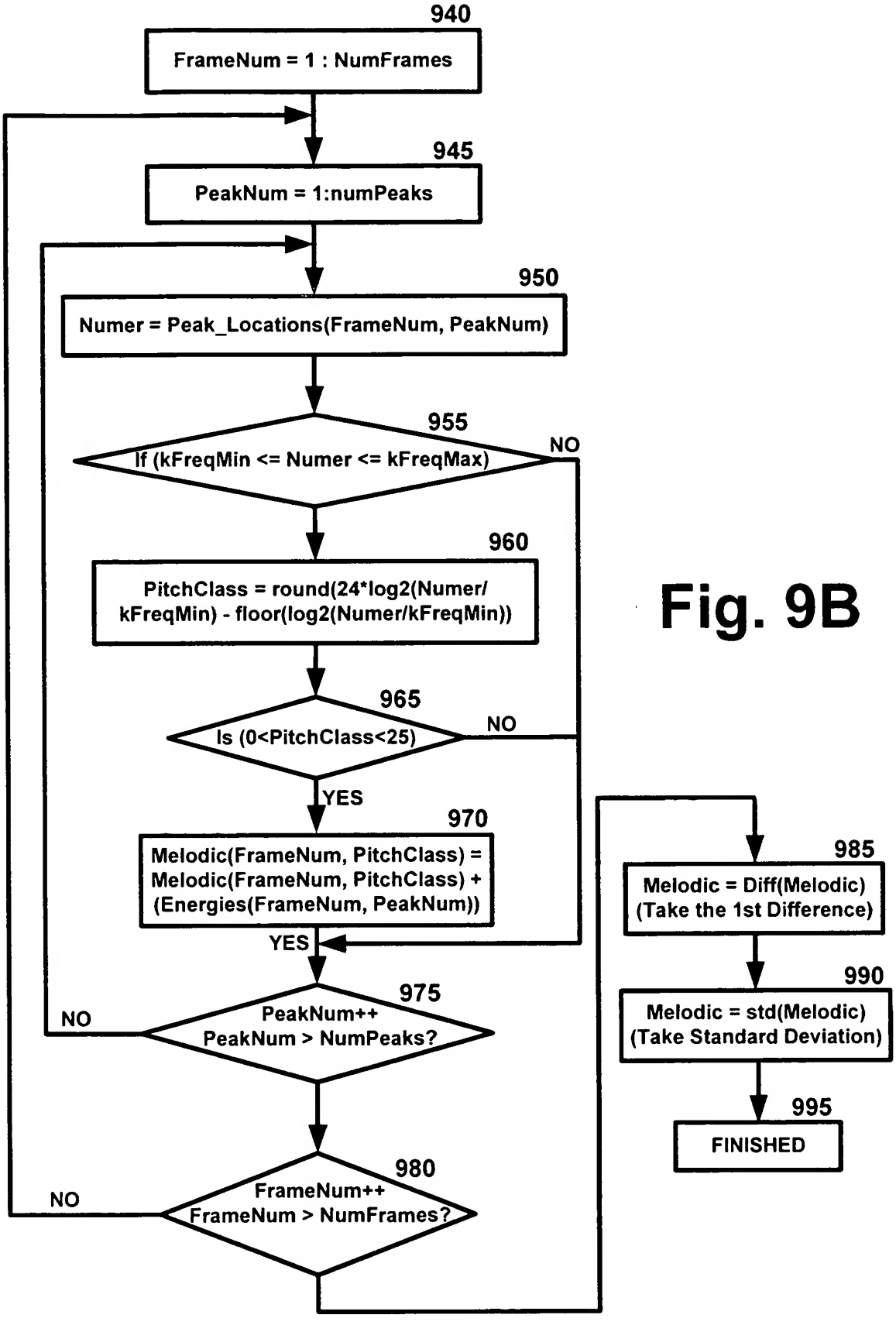

940
FrameNum = 1 : NumFrames
945
PeakNum = 1:numPeaks
950
Numer = Peak_Locations(FrameNum, PeakNum)
955
If (kFreqMin <= Numer <= kFreqMax)
NO
960
PitchClass = round(24*log2(Numer/ kFreqMin) - floor(log2(Numer/kFreqMin))
965
Is (0<PitchClass<25)
NO
YES
970
Melodic(FrameNum, PitchClass) = Melodic(FrameNum, PitchClass) + (Energies(FrameNum, PeakNum))
YES
975
PeakNum++ PeakNum > NumPeaks?
NO
980
FrameNum++ FrameNum > NumFrames?
NO
985
Melodic = Diff(Melodic) (Take the 1st Difference)
990
Melodic = std(Melodic) (Take Standard Deviation)
995
FINISHED

Fig. 9B

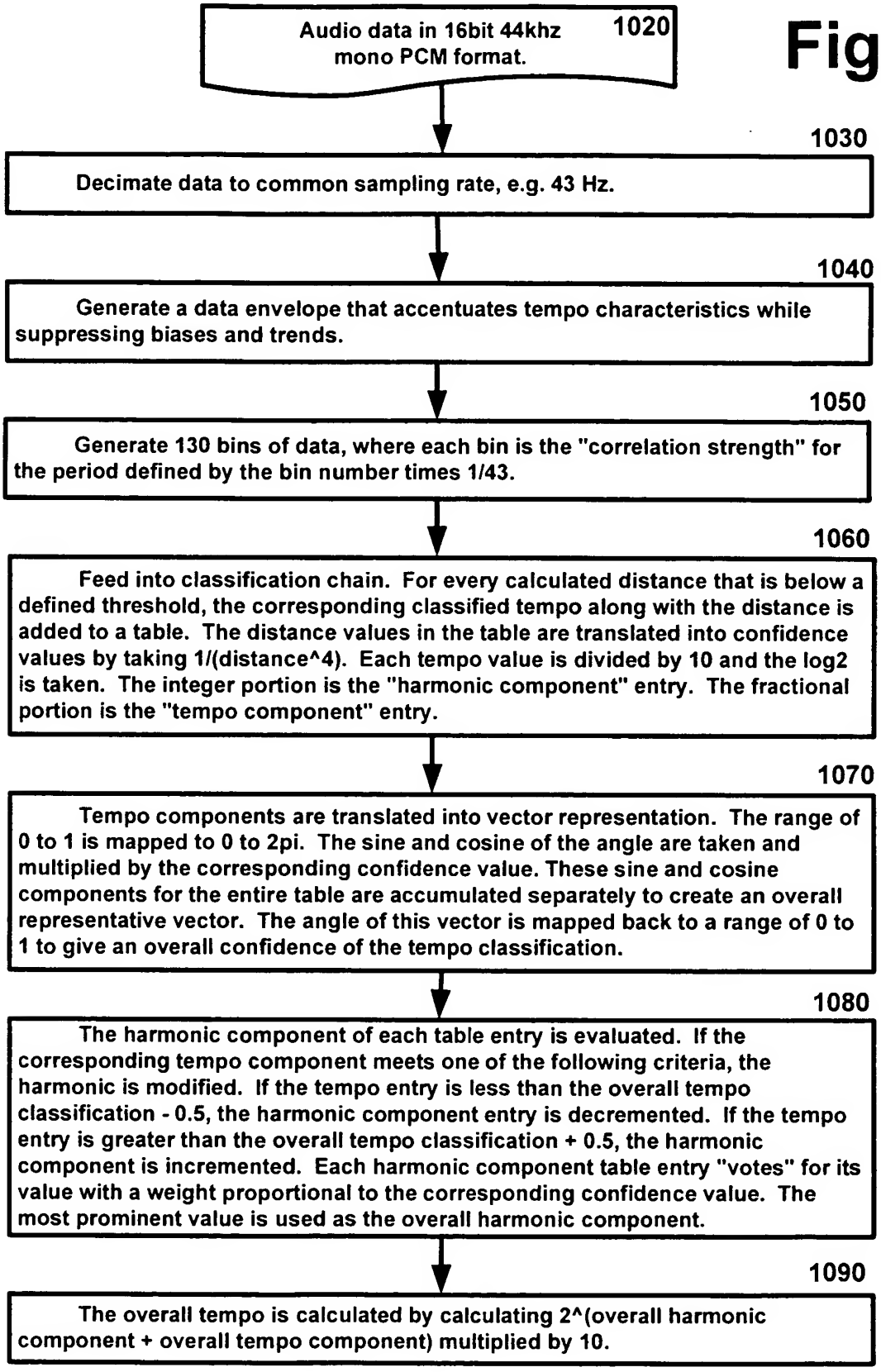

Audio data in 16bit 44khz mono PCM format.
1020
1030
Decimate data to common sampling rate, e.g. 43 Hz.
1040
Generate a data envelope that accentuates tempo characteristics while suppressing biases and trends.
1050
Generate 130 bins of data, where each bin is the "correlation strength" for the period defined by the bin number times 1/43.
1060
Feed into classification chain. For every calculated distance that is below a defined threshold, the corresponding classified tempo along with the distance is added to a table. The distance values in the table are translated into confidence values by taking 1/(distance^4). Each tempo value is divided by 10 and the log2 is taken. The integer portion is the "harmonic component" entry. The fractional portion is the "tempo component" entry.
1070
Tempo components are translated into vector representation. The range of 0 to 1 is mapped to 0 to 2pi. The sine and cosine of the angle are taken and multiplied by the corresponding confidence value. These sine and cosine components for the entire table are accumulated separately to create an overall representative vector. The angle of this vector is mapped back to a range of 0 to 1 to give an overall confidence of the tempo classification.
1080
The harmonic component of each table entry is evaluated. If the corresponding tempo component meets one of the following criteria, the harmonic is modified. If the tempo entry is less than the overall tempo classification - 0.5, the harmonic component entry is decremented. If the tempo entry is greater than the overall tempo classification + 0.5, the harmonic component is incremented. Each harmonic component table entry "votes" for its value with a weight proportional to the corresponding confidence value. The most prominent value is used as the overall harmonic component.
1090
The overall tempo is calculated by calculating 2^(overall harmonic component + overall tempo component) multiplied by 10.

Fig. 10